

Data Collection Activity - Modeling Exponential Decay

In this activity we are going to model "exponential decay" using a cup and M&M's.

Directions:

1. Dump the M&M's out on a piece of paper on your table. Count the total number of M&M's and then count the number of yellow M&M's.

Total number of M&M's in my cup: _____

Number of yellow M&M's in my cup: _____

2. Record the total number of M&M's that were in your cup in the chart below under "SPILL # 0" (which represents the initial amount) and also the number of yellow M&M's that were in your cup.

SPILL #	0	1	2	3	4	5	6	7	8	9	Yellow
My T total											
Class Total											

3. Here are the directions for completing the chart above.

- Put all of the M&M's back in the cup.
- Shake them and dump them out again.
- Separate the M&M's into two groups, the ACTIVE group and the INACTIVE group.

The ACTIVE group consists of all yellow M&M's plus all other M&M's with the "M" facing up.

The INACTIVE group consists of all M&M's that are not yellow with the "M" facing down.

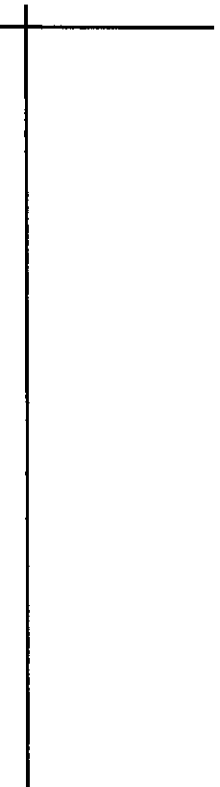
- Count the number of ACTIVE M&M's and record this number in the chart under SPILL #1. The INACTIVE M&M's are finished with this activity and they can be eaten!

- Repeat the above steps 9 times or until only yellow M&M's are left. That is, shake up the ACTIVE M&M's, dump them out, separate the ACTIVE ones from the INACTIVE ones, and count the ACTIVE M&M's. Record this number in the chart, and put the ACTIVE M&M's back into the cup and continue with these instructions.

4. When you are finished collecting and recording your data, put your results in the chart in the front of the class to calculate the "Class Total" data.

Analyzing the Data

5. Enter the data (that was discussed in class) in L1 (SPILL #) and L2 (Class Total) of your calculator and create a scatterplot. Show a sketch of the scatterplot below.



6. The graph of the data shows a relationship between the SPILL # and the Class Total of the amount of active M&M's, and is an example of an **exponential decay** problem. In Y1 use your ALPHA keys and enter the general exponential function: $Y1 = A \cdot B^X + C$.

7. To find the specific function that models the data, we need to find values for A, B, and C. C should be easy! (Hint: It's in your chart somewhere! We know it represents the vertical shift and/or the horizontal asymptote.) What would this value be?

C = _____

From the Home Screen, store this value in C. (_____ -> C)

A represents the "vertical stretch". The first data point should help you determine this value. $A = \underline{\hspace{2cm}}$ (It is not the total number of M&M's for the class! You also need to consider the "vertical shift".) From the Home Screen, store this value in A.

To find the value of B, select another ordered pair from your scatterplot, substitute the values for x and y into the exponential equation (along with the value of A and C), and solve for B. Show your work below.

B = _____.

From the Home Screen, store this value in B.

The final function we found (with values for A, B, and C) is $Y = \underline{\hspace{2cm}}$.

With your calculator, graph your function with the scatterplot to see how it fits the data. If your values for A and C are correct this value of B should give you a real good fit.)

8. Now, let's make our calculator find the best exponential function that fits the data. An exponential regression will find values for A and B. (Note: An exponential regression will find equations in the form: $Y = A \cdot B^{\wedge}X$, not $Y = A \cdot B^{\wedge}X + C$.)

First, we need to change the values in L2 by subtracting the "vertical shift" C. Place your cursor "on top" of L2 and enter $L2 = L2 - C$. You should see the values in L2 change. From the Home Screen do an exponential regression. (STAT, CALC 0:ExpReg) Write the regression equation with values rounded to 3 decimal places.

Y = _____

9. Return to L2 and add the value of C back in. ($L2 = L2 + C$) Enter this equation in Y2 and graph it. (Don't forget to add the value of C at the end of your equation.)

Does this equation fit *better*, *worse*, or about the *same* as the function that you found? Explain.

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10. Finally, let's see if we can answer some questions about the "real-world" meaning of the values of A, B, and C. (Use the exponential equation you found algebraically, not the regression equation.) C is the easiest. Explain the meaning of the value of C to the activity.

C: _____

Now, where does the value of A come from? (Hint: It is not the total number of M&M's for the class, but this number is used to determine A.)

A: _____

Finally, think about the value of B. (Hint: It represents a percent. A percent of what?)

B: _____